

Revision of the Lichen Genus *Menegazzia* (Ascomycotina: Parmelinaceae) in Eastern Asia

Kwang Hee MOON^a, Syo KUROKAWA^b and Hiroyuki KASHIWADANI^c

^aLaboratory of Mycology, School of Biological Sciences, Seoul National University, Seoul, 151-742 KOREA;
E-mail: moonroh@hotmail.com

^bBotanic Garden of Toyama, 42, Kamikutsuwada, Fuchu-machi, Toyama, 939-2713 JAPAN;

^cDepartment of Botany, National Science Museum, 4-1-1, Amakubo, Tsukuba, 305-0005 JAPAN

(Received on December 13, 2005)

Eastern Asian species of the genus *Menegazzia* are taxonomically revised: of the seven species recognized, *M. nipponica* K. H. Moon, Kurok. & Kashiw. and *M. squamatica* K. H. Moon, Kurok. & Kashiw. are newly described. *M. nipponica* is characterized by having elevated perforations, soralia, and by producing stictic acid. *M. squamatica* is distinguished from allied species by the presence of isidia, elevated perforations and by the presence of squamatic acid. *M. asahinae* is referred to those species with elevated perforations and esorediate lobes and producing caperatic acid as a major chemical substance, and *M. pedicellata* is synonymized with this species. A key is provided to the *Menegazzia* species of Eastern Asia.

Key words: Eastern Asia, lichens, *Menegazzia*, *Menegazzia nipponica*, *Menegazzia squamatica*.

Menegazzia (Lichenized Ascomycetes, Lecanorales) is a well-known foliose lichen genus with its main center of speciation in the Southern Hemisphere, comprising about 65 species in the world. However, only a few species have been reported from the Northern Hemisphere, especially from Eastern Asia where only four taxa, *M. asahinae* (Yasuda ex Asahina) R. Sant., *M. asahinae* f. *subimpertusa* (Asahina) Kurok., *M. dissecta* (Rass.) Hafellner and *M. terebrata* (Hoffm.) A. Massal., had been recognized (Rassadina 1964, Kurokawa 1971), until revisions by Aptroot et al. (2003) and Bjerke (2002, 2003, 2004) added several species, including some new to science, to its flora as follows: *M. anteforata* Aptroot, M. J. Lai & Sparrius, *M. caviisidia* Bjerke & P. James, *M. pedicellata* Bjerke, *M. pseudocyphellata* Aptroot, M. J. Lai & Sparrius, *M.*

primaria Aptroot, M. J. Lai & Sparrius and *M. subsimilis* (H. Magn.) R. Sant. Although the above authors provide a major contribution to our taxonomic knowledge of *Menegazzia* for the present area, their studies are based on a fairly small number of specimens. In the present study, Eastern Asian species are taxonomically revised, from morphological and chemical points of view, based on more than 500 specimens preserved in TNS, including materials recently collected by the authors.

Materials and Methods

Morphological characters were studied by means of light microscopy, with measurements made in GAW solution mounts, as well as under a dissecting microscope. Chemical substances were studied by color tests (Kurokawa 1964) and by the thin-layer

chromatography (Culberson 1972) using the solvent B system. Microcrystal tests for caperatic acid were also made following Asahina (1936, 1952). All specimens used for the present study are deposited in TNS, except for certain type specimens.

Menegazzia anteforata Aptroot, M. J. Lai & Sparrius in *Bryologist* **106**: 158 (2003).

Type collection: Taiwan, Miaoli Co., Shei-Pa National Park, 25 km ENE of Tungshi, near Tahsuehshan, 1600 m, on *Picea morrisonicola*, 8 October 2001, Aptroot 51931A (holotype in BM, isotype in ABL !).

Parmelia pertusa f. *subimpertusa* Nyl., Lich. Japon. 30. (1890) – *Menegazzia asahinae* f. *subimpertusa* (Nyl.) Kurok. in Misc. Bryol. Lichenol. **5**: 129 (1971).

Type collection: Japan, Fusi-yama (Mt. Fuji), 1879, E. Almquist s. n. (holotype in S !, isotype in UPS).

Chemistry: atranorin, stictic acid (major), constictic acid, menegazziaic acid, cryptostictic acid, norstictic acid.

This species is characterized by the non-sorediate thalli with convex lobes, the conically elevated perforations, the cupuliform and subpedicellate apothecia, the apothecial margin often with distinct perforations and cracks, and the presence of stictic acid as a major chemical substance.

According to Aptroot et al. (2003), *M. anteforata* is characterized by the common occurrence of perforations on the lobe tips. However, both terminal and laminal perforations were observed in the isotype and other specimens examined, so it cannot be considered as a good taxonomic character.

This species corresponds to the so-called "*M. asahinae*" in Eastern Asia. As discussed below, caperatic acid was demonstrated in the type specimen of *M. asahinae*, therefore the name, *M. asahinae*, cannot be used for species containing stictic acid.

Menegazzia anteforata is corticolous and widely distributed in Eastern Asia, where it has been collected in mountainous regions of Japan (Honshu, Shikoku, Kyushu), Korea and Taiwan at elevations above ca. 700 m.

Representative specimens examined. **Japan.** Honshu. Prov. Mutsu (Pref. Aomori): en route from Sarukura Hot Spring to the top of Mt. Norikura, Towada-city, on bark of *Abies mariesii*, ca 1150 m, August 16, 1986, H. Kashiwadani 23988. Prov. Uzen (Pref. Yamagata): N slope of Mt. Nakadaiten, Azuma, Yonezawa-city (37°46'N, 140°08'E), on bark of *Abies mariesii*, 1400–1600 m, May 30, 1995, K. H. Moon 458. Prov. Iwashi (Pref. Fukushima): en route from Shirabu Pass to Babayachi, Mt. Yahazu, Azuma, Yama-gun (37°44'N, 140°06'E), on bark of *Fagus crenata*, 1400–1500 m, May 31, 1995, K. H. Moon 6. Prov. Shimotsuke (Pref. Tochigi): Mt. Nantai, Nikko, ca 1780 m, June 14, 1981, H. Kashiwadani 16958. Prov. Musashi (Pref. Saitama): Mt. Kobushi-dake, Ohtaki-mura, Chichibu-gun, on fall tree, ca. 2450 m, August 19, 1992, H. Shibuichi 9118. Prov. Shinano (Pref. Nagano): on trail from Mt. Yoko-dake to Akadake-Kohsen Lodge, Yatsuga-dake, Chino-shi, on trunk of *Abies veitchii*, ca 2400 m, August 10, 1988, H. Shibuichi 8485. Prov. Kai (Pref. Yamanashi): on trail from Mt. Kobushi to Karisaka Pass, August 25, 1953, S. Kurokawa 521023. Prov. Suruga (Pref. Shizuoka): Ohmiya-guchi 3-gome, Mt. Fuji, November 25, 1934, Y. Asahina 341125. Prov. Izu (Pref. Shizuoka): Mt. Amagi, August 25, 1930, Y. Asahina 3082. Prov. Ise (Pref. Miyagi): Ohdaigahara, August 13–15, 1961, M. Togashi (herb. no. 26552). Prov. Yamato (Pref. Nara): Mt. Ohmine, Yoshino-gun, ca. 1700 m, July 23, 1969, H. Kashiwadani 6091. Shikoku. Prov. Iyo (Pref. Ehime): Mt. Ishizuchi, Ishizuchi, 1850–1980 m, August 3, 1968, H. Kashiwadani 5353. Prov. Tosa (Pref. Kochi): Mt. Tengu, Aki-gun, on bark of *Rhododendron* sp., ca. 1000 m, August 23, 1969, H. Kashiwadani 6513. Kyushu. Prov. Ohsumi (Pref. Kagoshima): near Ishizuka-goya hut, Yakushima Island, on trunk of *Abies firma*, 1600 m, July 26, 1984, K. Yoshida 6412. **Taiwan.** Taipei Co.: Doba-Ekijiu Gorge, Rato-gun, July 26, 1934, M. Tagawa 150. Hualien Co.: Mt. Houanshan, Shulin, on branch of *Pleuroblastus* sp., ca. 3150 m, July 31, 1985, K. Yoshida 7036. Taichung Co.: Tashuehsan Forest Park, below Hsiao-shuehshan Hostel, near giant *Chamaecyparis formosaensis*, Hopen (24°17'N, 121°02'E), on bark of *Pinus taiwanensis*, ca. 2550–2580 m, November 30, 2002, K. H. Moon 6365; Bayu Lake, on twigs, ca 2200 m, January 21, 1965, S. Kurokawa 2408; Hattjukan, Niitaka-gun, July 31, 1935, T. Suzuki (herb. Y.

Asahina 35731). Nantou Co.: Wuling, Hohuanshan., Jen-Ai Hsiang (24°24'N, 121°28'E), on bark of *Abies kawakamii*, ca. 3300m, March 8, 2003, H. Kashiwadani 45413. Chiayi Co.: Mt. Alisan, July 14, 1935, M. Ogata (herb. Y. Asahina 3574).

Menegazzia asahinae (Yasuda ex Asahina) R. Sant. in Ark. Bot. **30A** (11): 13 (1942).

Parmelia asahinae Yasuda ex Asahina in Bot. Mag. Tokyo **41**: 374 (1927).

Type collection: Japan, Prov. Idzu (Pref. Shizuoka), on summit of Mt. Manzaburo, Amagi, 4 Sep. 1922, Y. Asahina s. n. (holotype in TNS !).

Menegazzia pedicellata Bjerke in Lichenologist **36**: 21 (2004).

Type collection: Japan, Prov. Idzu, Mt. Amagi, 4 Sep. 1922, Y. Asahina s. n. (pr. p., holotype in TNS !).

Chemistry: atranorin, caperatic acid.

When Bjerke (2004) revised Japanese species of *Menegazzia*, he designated the illustration given by Asahina (1927) as an epitype of *Parmelia asahinae*, since he could not locate the holotype specimen at that time. However, during the present study, we did

locate a specimen identical to that illustrated by Asahina (Fig. 1) in Asahina's Herbarium preserved in TNS. Since Asahina cited only one specimen in his original description, this specimen is surely the holotype of *P. asahinae*. In the holotype specimen, lobes are not sorediate and form elevated perforations, and atranorin and caperatic acid were present as determined by TLC and MCT, features which coincide well with those of *Menegazzia pedicellata*. Consequently, *M. pedicellata* is synonymized with *M. asahinae* (Bjerke 2004) in this paper.

When Asahina (1932, 1950) described the morphology and chemistry of *Parmelia asahinae* in detail, he thought it was characterized by esorediate or rarely sorediate lobes with elevated perforations and by the presence of stictic acid. Following his concept, the name *Menegazzia asahinae* has long been applied to the stictic acid containing taxon in Japan, but, as mentioned above, such a taxon must be identified with *M. anteforata*.

Menegazzia asahinae very much resembles *M. anteforata* since they both have thalli

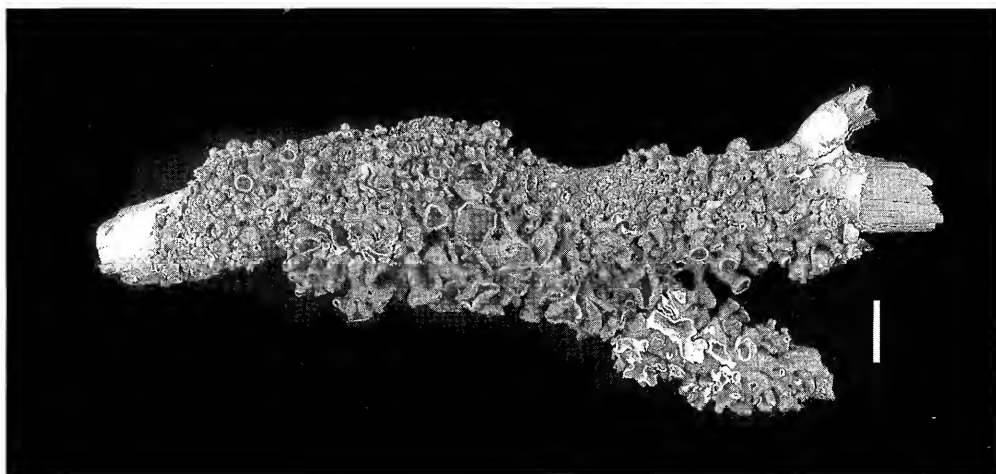


Fig. 1. Holotype of *Menegazzia asahinae* (Yasuda ex Asahina) R. Sant. (Y. Asahina s. n., TNS). Bar = 2 mm.

with elevated perforations; however, the latter contains stictic acid not caperatic acid.

Menegazzia asahinae is endemic to Japan, being collected only from Mt. Amagi and Mt. Fuji, where it grows on twigs of trees.

Specimens examined. **Japan.** Honshu. Prov. Izu (Pref. Shizuoka): Mt. Amagi, August 24, 1927, Y. Asahina 27824. Prov. Suruga (Pref. Shizuoka), Ohmiya-guchi 1-2 gome, Mt. Fuji, August 21, 1930, Y. Asahina 3021 (pr. p.); Gotemba, July 1930, Y. Asahina 1050.

Menegazzia caviisidia Bjerke & P. James in *Lichenologist* **36**: 20 (2004).

Type collection: Japan, Honshu, Prov. Hida: Mt. Ontake, above Nigorigawa Hot Spring, 1900–2100 m, August 11, 1964, I. Yoshimura 64007 (holotype in BM, not seen).

When Bjerke (2004) described this species, they cited only three specimens from Japan. However, it is rather widely distributed in Japan, from Tochigi Pref. southwards to Wakayama Pref. in Honshu; it also occurs in Taiwan.

Representative specimens examined. **Japan.** Honshu. Prov. Shimotsuke (Pref. Tochigi): Mt. Koshin, Kamitsuga-gun, on trunk of *Tsuga diversifolia*, ca. 1800 m, September 26, 1984, H. Shibuichi 7780. Prov. Musashi (Pref. Saitama): Karisaka Pass, Chichibu, on trunk of *Tsuga diversifolia*, ca. 2000 m, May 25, 1970, S. Kurokawa 70158. Prov. Etchu (Pref. Toyama): Mt. Yakushi-dake Tateyama, ca. 1800 m, July 29, 1976, K. Yoshida 2103. Prov. Shinano (Pref. Nagano): en route between Shibunoyu Hot Spring and Mt. Takami-ishi, Yatsugatake, ca. 2120 m, September 1, 1980, H. Kashiwadani 16146; en route between Suzuran and Reizen, Mt. Norikura, August 5, 1952, Y. Asahina (herb. no. 26569). Prov. Kai (Pref. Yamanashi): Goten-niwa, Mt. Fuji, ca 970 m, May 26, 1963, S. Kurokawa 63019. Prov. Hida (Pref. Gifu): Nigorigo Hot Spring, Mt. Ontake, on bark of *Pinus parviflora*, ca. 1760 m, August 15, 1964, S. Nakanishi 105. Prov. Kii (Pref. Wakayama): Mt. Koya, August 18, 1940, Y. Numajiri. **Taiwan.** Taichung Co.: Tashueshan Forest Park, Anmashan (km 43 on Tashueshan road), Hopin (24°15'N, 121°00'E), on bark of *Pinus taiwanensis*, 2260 m, November 29, 2002, K. H. Moon 6305; en route from Suyen to Mt. Nanhutashan, Hopin, on bark of *Pinus* sp., ca 2600 m,

November 9–13, 1989, K. Yoshida 9794.

Menegazzia nipponica K. H. Moon, Kurok. & Kashiw., sp. nov. [Fig. 2]

Affinis *Menegazzia anteforatae*, sed thallo sorediato differt.

Type collection: Japan, Honshu, Prov. Kai (Yamanashi Pref.), Narusawa-guchi 5-gome, Mt. Fuji, ca. 2300 m, 12 Sept. 1970, S. Kurokawa 70883 (holotype in TNS)

Chemistry: atranorin, stictic acid, constictic acid, menegazziaic acid, cryptostictic acid, norstictic acid.

Thallus corticolous, closely attached, forming rosettes up to 6 cm in diam. Lobes more or less irregularly branched, inflated, slightly convex, secondary lobes numerous, up to 2 mm wide. Upper surface greenish-gray in fresh material, reddish-brown in old specimens, sorediate; soredia granular, developed along lacerate or flange-like margins on elevated perforations. Lower surface black or dark near the center of lobes, brown to pale brown towards the apices, rarely perforated, rhizines sparse, up to 1 mm in length (Fig. 2c). Apothecia not seen.

Menegazzia nipponica is characterized by the lobes with scattered elevated perforations and marginal lobules (Fig. 2b), the presence of soralia, and the production of stictic acid as a major chemical substance. Morphologically, especially in lobe configuration, this species is similar to *M. anteforata*, which can be considered to be the non-sorediate parental taxon.

Menegazzia nipponica has been collected only in Japan, where it is rather widely distributed from Hokkaido to Kyushu.

Representative specimens examined. **Japan.** Hokkaido. Prov. Kitami: Himenuma Pond, Rishiri Island, on trunk of *Abies sachalinensis*, ca. 120 m, August 13, 1970, S. Kurokawa 70746. Prov. Teshio: Wakkasakanai, Toyotomi-machi, on trunk of *Abies sachalinensis*, ca. 20 m, August 10, 1970, S. Kurokawa 70660. Honshu. Prov. Shimotsuke (Pref. Tochigi), Lake Suganuma, Nikko, July 23, 1930, A. Hashimoto 265386. Prov. Musashi (Pref. Saitama): east Valley of

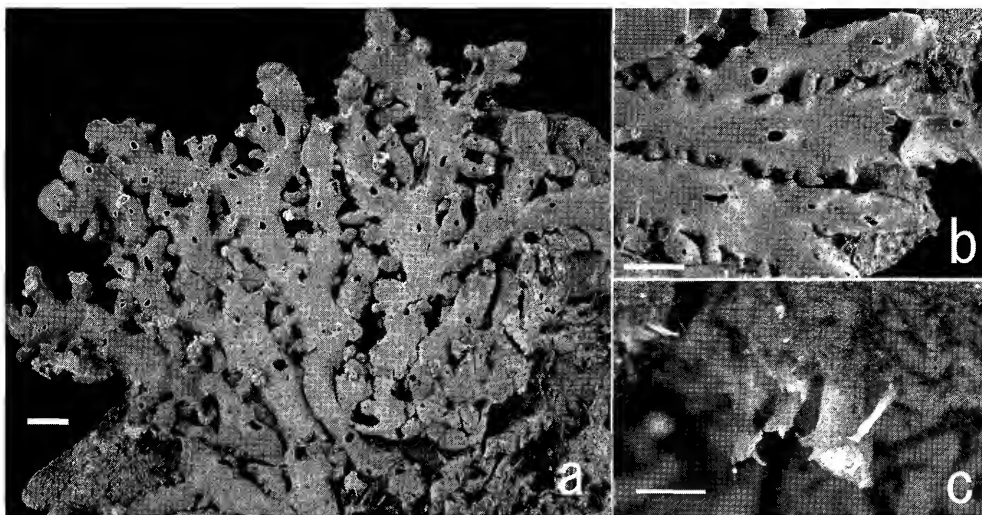


Fig. 2. Holotype of *Menegazzia nipponica* K. H. Moon, Kurok. & Kashiw. (S. Kurokawa 70883, TNS). a: Part of holotype. b: Marginal lobules. c: Rhizines. Bar = 2 mm.

Ohchigawa River, Chichibu, November 15, 1950, S. Kurokawa 50433. Prov. Shinano (Pref. Nagano): Mt. Yoko-dake, Yatsuga-take, Chino-city, on bark of *Abies veitchii*, ca. 2500 m, August 10, 1988, K. Yoshida 8885. Prov. Kai (Pref. Yamanashi): along Subaru Line, Narusawa-mura Minamitsuru-gun, on bark of *Abies veitchii*, ca. 2200 m, December 10, 2004, H. Kashiwadani 47559. Prov. Suruga (Pref. Shizuoka): Subashiri-guchi 1-gome, Mt. Fuji, August 21, 1929, Y. Asahina (herb. Y. Asahina 1046). Kyushu. Prov. Buzen (Pref. Fukuoka): Mt. Hikosan, November 18, 1962, S. Kurokawa 62472.

Menegazzia primaria Aptroot, M. J. Lai & Sparrius in *Bryologist* **106**: 158 (2003).

Type collection: Taiwan, Hualien Co., Taroko National Park, Hohuan Shan, near Field Station, 3200 m, on *Abies kawakamii*, 12 Oct. 2001, Aptroot 52661 (holotype in BM, isotype in ABL !).

Menegazzia pseudocyphellata Aptroot, M. J. Lai & Sparrius in *Bryologist* **106**: 158 (2003).

Type collection: Taiwan, Hualien Co., Taroko National Park, Hohuan Shan, exposed mountain ridge, 3000 m, on *Pinus*

taiwanensis, 12 Oct. 2001, Aptroot 53687; (holotype in BM, isotype in ABL !).

Chemistry: atranorin, stictic acid, constictic acid, menegazziaic acid, cryptostictic acid, norstictic acid.

Menegazzia primaria is easily distinguished from allied species by the convex and imbricate lobes with flushed perforations, the absence of soredia, and the production of stictic acid. It should also be noted that this species usually produces a lot of pycnidia throughout the upper surface of lobes, especially near the periphery.

Because of the convex and inflated lobes, this species often has flush to slightly raised perforations; however, it never forms typical elevated perforations as found in the *M. asahinae* group; *M. anteforata*, *M. asahinae* and *M. nipponica*.

Menegazzia primaria is apparently highly variable with regard to cracks or perforations on the margin of apothecia. Aptroot et al. (2003) described a new species, *M. pseudocyphellata*, from Taiwan emphasizing

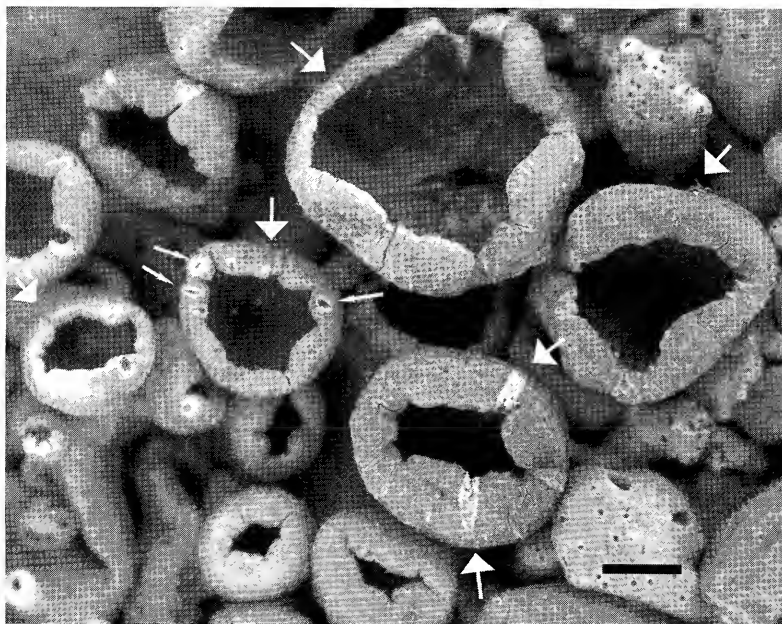


Fig. 3. Apothecia of *Menegazzia primaria* Aptroot & al., showing entire to crenate margins with or without perforations (narrow arrows) and cracks (thick arrows) in a single specimen (H. Kashiwadani 45402, TNS). Bar = 1.5 mm.

the presence of cracked or pseudocyphellate margins to the apothecia, with the margins of the perforations flush to slightly raised. However, it is apparently an ecological form of *M. primaria* (Fig. 3) and can therefore be reduced to a synonym of that the species.

Menegazzia primaria is one of the common species of *Menegazzia* in Eastern Asia, occurring in Japan (Hokkaido to Kyushu), Korea and Taiwan, where it grows on bark or on rocks in cool temperate forests.

Representative specimens examined. **Japan.** Hokkaido. Prov. Kushiro: Horonai, Kushiro-cho, Kushiro-gun, on bark of *Abies sachalinensis*, ca. 130 m, October 11, 2004, H. Kashiwadani 47459. Honshu. Prov. Rikuchu (Pref. Iwate): Mt Hayachine, Hienuki-gun, on trunk of *Fagus crenata*, ca. 1250 m, August 1, 1987, H. Shibuichi 8345. Prov. Iwaki (Pref. Fukushima): Mt Sambon-Yari, Nishi-Shirakawa-gun, ca. 1560 m, August 1, 1978, S. Kurokawa 78005. Prov. Iwashi (Pref. Fukushima): en route from Shirabu

Pass to Babayachi, Mt. Yahazu, Azuma, Yama-gun (37°44'N, 144°06'E), on bark of *Fagus crenata*, 1400–1500 m, May 31, 1995, K. H. Moon 33. Prov. Hitachi (Pref. Ibaraki): Mt. Tsukuba, March 1, 1924, Y. Asahina 2431. Prov. Shimotsuke (Pref. Tochigi): Lake Kirikomi, Nikko, May 3, 1931, Y. Asahina (herb. Y. Asahina 1055). Prov. Kohzuke (Pref. Gunma): en route from Hatomachi Pass to Mt. Akusawa-dake, Katashina-mura, Tone-gun, on decayed wood, 1600–1860 m, October 9, 2001, K. H. Moon 6097. Prov. Musashi (Pref. Saitama): on trail from Mikuni Pass to Jyumonji Pass, Chichibu-gun, on bark of *Quercus crispula*, 1700–1840 m, October 16, 2004, H. Kashiwadani (47362) & K. Yoshida. Prov. Sagami (Pref. Kanagawa): Sengokubara, Hakone, October 17, 1935, M. Kishida (herb. Y. Asahina 35107). Prov. Etchu (Pref. Toyama): Lakeside of Kurobe-ko, Tateyama, 1450–1900 m, August 26, 1988, S. Kurokawa 88098. Prov. Shinano (Pref. Nagano): Ishinokami, Kami-mura, Shimoina-gun, ca. 1000 m, July 31, 1966, M. Togashi (herb. no. 26533). Prov. Kai (Pref. Yamanashi): Goten-niwa, Mt Fuji, ca. 970 m, April 11, 1970, S. Kurokawa 70084. Prov. Suruga

(Pref. Shizuoka): Ubasawa, on bark of *Fagus crenata*, ca. 1250 m, August 9, 1954, T. Suzuki. Prov. Izu (Pref. Shizuoka): Mt. Amagi, August 24, 1929, Y. Asahina 29824. Prov. Ise (Pref. Miyagi): Mt. Gozaisho, 1952, Y. Asahina 52001. Prov. Yamato (Pref. Nara): Mt. Ohmine, Yoshino-gun, ca. 1500 m, July 23, 1969, H. Kashiwadani 6073. Prov. Kii (Pref. Wakayama): Mt. Koya, ca. 800 m, April 4, 1956, S. Kurokawa 56059. Prov. Inaba (Pref. Tottori): Mt. Hyonosen, July 27, 1930, K. Yasuda s. n. Prov. Hoki (Pref. Tottori): Yamagawa-mura, July 17, 1931, K. Yasuda s. n. Prov. Iwami (Pref. Shimane): Mt. Sanbe, Ohda city, ca. 980 m, July 19, 1968, H. Kashiwadani 5550. Prov. Mimasaka (Pref. Okayama): Hoshiyama, Katsuyama cho, Maniwa-gun, ca. 500 m, April 3, 1975, H. Kashiwadani 13062. Prov. Bingo (Pref. Hiroshima): Mt. Hiba, Hiba-gun, on bark of *Fagus crenata*, ca. 1170 m, October 12, 1973, H. Kashiwadani 8383. Prov. Aki (Pref. Hiroshima): Mt. Togo, Saiki-gun, ca. 920 m, May 4, 1966, H. Kashiwadani 162. Shikoku. Prov. Awa (Pref. Tokushima): Mt. Kenzan (Mt. Tsurugisan), August 20, 1934, F. Fujikawa (herb. Y. Asahina 3488). Prov. Iyo (Pref. Ehime): Mt. Takanawa, Hojo city, on bark of *Fagus crenata*, ca. 980 m, May 18, 1969, H. Kashiwadani 6167. Prov. Tosa (Pref. Kochi): Mt. Kuishi, on rock, 950–1150 m, November 3, 1974, H. Kashiwadani 12645. Kyushu. Prov. Buzen (Pref. Fukuoka): Mt. Hikosan, Soeda-cho, Tagawa-gun, on bark of *Zelkova serrata*, ca. 730 m, October 9, 1996, H. Kashiwadani (40034) & Y. Umezu. Prov. Bungo (Pref. Oita): en route from Notohge Pass to Mt. Ichino-dake, Yamakuni-cho, Shimoge-gun, on bark of *Carpinus* sp., 720–910 m, October 10, 1996, H. Kashiwadani (39949) & Y. Umezu. Prov. Higo (Pref. Kumamoto): Mt. Ichibusa, August 9, 1933, F. Fujikawa (herb. Y. Asahina 3389). Prov. Satsuma (Pref. Kagoshima): Mt. Kaimon-dake, Ibusuki-gun, ca. 940 m, August 22, 1962, M. Togashi (herb. no. 26677). **Korea.** Prov. Kangwon: en route from Mt. Daechongbong to Hiungag hut, Mt. Sorak, Sokcho city (38°07'N, 128°28'E), on bark of *Pinus densiflora*, 1400–1708 m, *Betula ermanii* dominated forest, July 18, 1996, K.H. Moon (1301) & H. Kashiwadani. Prov. Cheju: along trail of Songpanak en route to the summit, Mt. Halla, Namwon-up, Namcheju-gun, Cheju Island (33°21'N, 126°32'E), on bark of *Abies* sp., ca. 1500 m, May 28, 2001, M. Inoue 28735. **Taiwan.** Hualien Co.: Mt. Hohuanshan, Shulin, on twig of tree, ca. 3100 m, July 31, 1985, K. Yoshida 7037. Taichung Co.: Tashueshan Forest Park, on road to near by summit areas of Mt. Tashueshan, Hopen (24°17'N, 121°02'E), on bark of *Chamaecyparis formosensis*, ca. 2980 m, November 29, 2002, K. H. Moon 6339; Mt.

Wunitoparu, ca. 1900 m, January 23, 1965, S. Kurokawa 2590. Nantou Co.: Wuling, Hohuanshan, Jen-Ai Hsiang (24°24'N, 121°28'E), on bark of *Rhododendron* sp., ca. 3300 m, March 8, 2003, H. Kashiwadani 45402. Chiayi Co.: Nimantaira, Mt. Arisan, December 25, 1925, Y. Asahina F-72.

Menegazzia squamatica K. H. Moon, Kurok. & Kashiw., sp. nov. [Fig. 4]

Similis *Menegazziae caviisidiae*, sed acidum squamaticum continenti differt.

Type collection: Japan, Honshu, Prov. Shinano, Mt. Nishi-komagatake, July 28, 1926, Y. Asahina 50 (holotype in TNS).

Thallus corticolous, closely attached, forming rosettes up to 6 cm in diam. Lobes irregularly branched, imbricate, inflated to convex, up to 2.5 mm wide. Upper surface yellowish-green to brownish-gray in old specimens, isidiate; isidia laminal, globose, more or less constricted at the base, variable in shape, becoming elongated and dactyliiform, often divided and with minute perforations, scattered and sometimes lacking on younger lobes. Perforations elevated, scattered. Lower surface black in the center, dark brown towards the margins, perforations very scarce or almost absent. Apothecia and pycnidia not seen.

Chemistry: atranorin, squamatic acid.

Menegazzia squamatica is characterized by having isidia, elevated perforations and producing squamatic acid as a medullary substance. It is morphologically similar to *M. caviisidia*, which differs in producing thamnolic acid.

Menegazzia squamatica is distributed in limited areas in central Honshu, Japan, being collected from Saitama, Nagano and Toyama Prefectures, where it grows on the bark of coniferous trees especially on *Tsuga diversifolia* and *T. sieboldii* at elevations above ca. 1500 m.

Specimens examined. **Japan.** Honshu. Prov. Iwashiro (Pref. Fukushima): Mt. Shibutsu, Oze, August 7, 1970, K. Yoshida 3. Prov. Musashi (Pref. Saitama), Jyumonji Pass, Chichibu-gun, on trunk of *Tsuga*

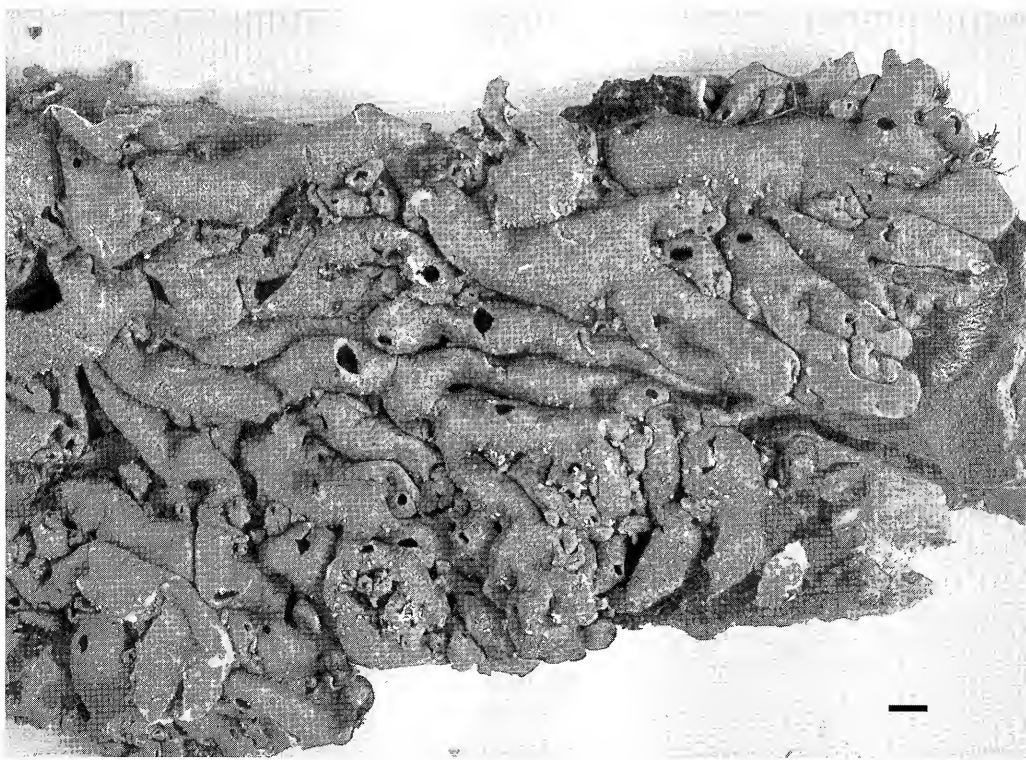


Fig. 4. Holotype of *Menegazzia squamatica* K. H. Moon, Kurok. & Kashiw. (Y. Asahina 50, TNS).
Bar = 1 mm.

diversifolia, ca. 2000 m, August 10, 1972, H. Shibuichi 4723; the same locality, June 14, 1975, K. Yoshida 1784; Zizoh-iwa, Karisaka Pass, ca. 1800 m, August 27, 1976, K. Yoshida 2196. Prov. Etchu (Pref. Toyama): Lakeside of Kurobe-ko, Tateyama, 1450–1900 m, August 26, 1988, S. Kurokawa 88097. Prov. Shinano (Pref. Nagano), Mt. Kinpu, 2100–2450 m, July 28, 1965, S. Kurokawa 178.

***Menegazzia terebrata* (Hoffm.) A. Massal.** in Neagen. Lich.: 3 (1854).

Menegazzia subsimilis (H. Magn.) R. Sant. in Ark. Bot. **30A** (11): 13 (1942) – *Parmelia subsimilis* H. Magan. in Ark. Bot. **30B** (3): 5 (1941).

Type collection: Hawaii, Kauai, Lehua makanoe, on *Wikstroemia*, 15 Aug. 1938, L. M. Cranwell, O. Selling & C. Skottsberg 6304 (holotype in UPS !)

Menegazzia terebrata is a well-recognized species widely distributed in the Northern Hemisphere. It is easily distinguished from allied species by the inflated lobes with flat perforations and various types of soralia or pustules, and by producing stictic acid as a major medullary substance. Although type material of this species was not examined, the specimens from the present area are very similar to the exsiccate specimens distributed from Europe as cited below.

Bjerke (2004) reported the occurrence of *M. subsimilis* in Japan, distinguishing it from *M. terebrata* mainly by the presence of elevated, lacerate and flange-like soralia, instead of convex and non-lacerate soralia found in the latter. However, such variation

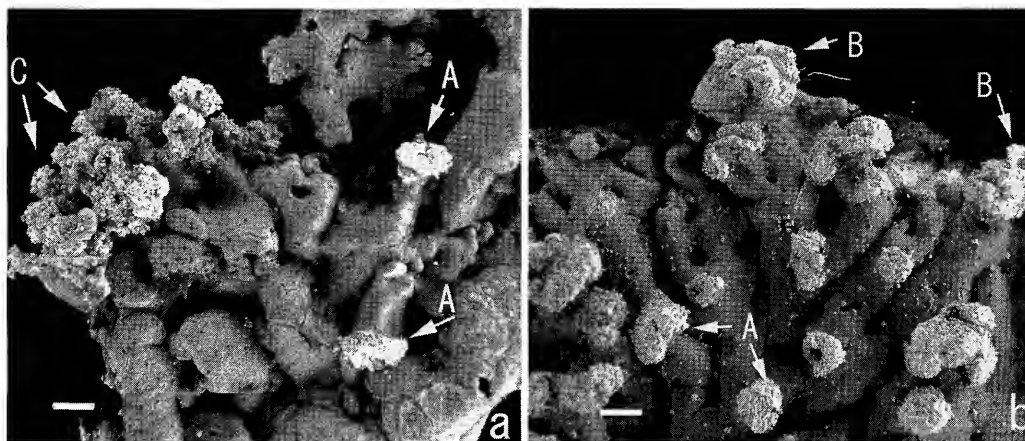


Fig. 5. Variations of soralia in *Menegazzia terebrata* (Hoffm.) A. Massal. (a: H. Shibuichi 2042; b: H. Shibuichi 3709). A: The hemiglobose and convex soralia. B: The semi-lacerate soralia developed from A. C: The lacerate and funnel-shaped soralia at a well-developed stage. Bar = 1 mm.

of soralia seems to be continuously observed in a single specimen or even a single soralium (Fig. 5). In fact, it is hardly possible to separate *M. subsimilis* from *M. terebrata* by the soralia characters stated by Bjerke (2004), at least in the Eastern Asian and Hawaiian specimens. Therefore these features do not seem to be a good taxonomic character to separate species.

Menegazzia terebrata shows a cosmopolitan distribution and is one of the commonest species of *Menegazzia* in the Eastern Asia where it is distributed from lowlands to subalpine regions at elevations from 5 to 3300 m.

Exsiccata examined. W. Obermayer: Lichen. Graec. 88 (TNS). J. Poelt: Lichen. Alpium 308 (TNS).

Representative specimens examined. **Japan.** Hokkaido. Prov. Kitami: Bihoro Pass, June 27, 1953, Y. Asahina & M. Togashi (herb. no. 26627). Prov. Kushiro: Mt. O-Akan, on trunk of *Abies sachalinensis*, ca 440 m, August 30, 1965, S. Kurokawa 65695. Prov. Tokachi: Mt. Higashi-Nupukaushi, Shikaoimura, Kato-gun, on bark of *Abies veitchii*, ca. 1000 m, June 26, 1979, H. Kashiwadani 15207. Prov. Ishikari: Furebetsu, Mt. Furano, on trunk of *Abies sachalinensis*, ca. 600 m, August 24, 1965, S. Kurokawa 65505. Prov. Hidaka: Mt. Petegari, on trunk of *Betula erna-*

nii, ca. 1150 m, July 29, 1970, S. Kurokawa 70436. Prov. Iburi: Shishamonai, Chitose city, ca. 900 m, July 21, 1970, H. Kashiwadani 8355. Honshu. Prov. Mutsu (Pref. Aomori): en route from Sarukura Hot Spring to the top of Mt. Norikura, Towada-city, on tree bark of *Abies sachalinensis*, ca. 900 m, August 16, 1986, H. Kashiwadani 23956. Prov. Iwaki (Pref. Fukushima): Matsukawaura, December 5, 1964, S. Kurokawa 64463. Prov. Shimotsuke (Pref. Tochigi): Nanbo, Kurobane-cho, Nasu-gun, on bark of *Acer* sp., ca. 500 m, August 11, 1984, H. Kashiwadani 20745. Prov. Kozuke (Pref. Gunma): Hoshi Hot Spring, April 27, 1960, Y. Asahina & M. Nuno (herb. no. 26633). Prov. Musashi (Pref. Saitama): on trail from Mikuni Pass to Jumonji Pass, Chichibu-gun, on twig of *Larix leptolepis*, ca. 1850 m, June 22, 1988, K. Yoshida 8606. Prov. Sagami (Pref. Kanagawa): Saijoji Temple, Mt. Daiyusan, Odawara, May 23, 1957, M. Togashi & M. Nuno (herb. Y. Asahina 57523). Prov. Etchu (Pref. Toyama): Buna-zaka, Tateyama, Naka-Niikawa-gun, on bark of *Fagus crenata*, ca. 1100 m, November 12, 1998, H. Shibuichi (9975) & K. Yoshida. Prov. Shinano (Pref. Nagano): en route from Minoto Lodge to Akadake-kohsen, Mt. Yatsuga-take, Chino-city, on bark of *Abies veitchii*, 1950–2200 m, September 27, 2004, H. Kashiwadani (47095) & K. Yoshida. Prov. Kai (Pref. Yamanashi): Experimental Forest of Tokyo University, Yamanakako-mura, Minami-Tsuru-gun, ca. 1000 m, June 5, 1980, H. Kashiwadani 16009. Prov. Suruga (Pref. Shizuoka): en route from Niken-goya lodge to the Senmai-goya lodge, Mt. Arakawa, 1300–

2700 m, August 5, 1974, H. Kashiwadani 12741. Prov. Izu (Pref. Shizuoka): Mt. Amagi, December 22, 1967, T. Komiya s. n. Tohtomi (Pref. Shizuoka), Mukai-ichiba, Misakubo-cho, Iwata-gun, ca. 600 m, March 26, 1965, M. Togashi (herb. no. 26651). Prov. Mikawa (Pref. Aichi): Mt. Horaiji, January 7, 1956, Y. Asahina 5671. (herb. no. 26571). Prov. Ohmi (Pref. Shiga): Hikone, ca. 90 m, October 25, 1976, H. Kashiwadani 13507. Prov. Ise (Pref. Miyagi), Mt. Gozaisho, 1952, Y. Asahina 5621 (herb. no. 26572). Prov. Yamato (Pref. Nara): Mt. Ohmine, Yoshino-gun, ca. 1500 m, July 23, 1969, H. Kashiwadani 6073. Prov. Kii (Pref. Wakayama): Mt. Koya, December 17–18, 1960, S. Kurokawa 60223. Prov. Settsu (Pref. Hyogo): Vicinity of Karato, Mt. Rokko, November 17, 1964, S. Kurokawa 64336. Prov. Tango (Pref. Kyoto): Nariai Temple, Miyazu, July 7, 1956, M. Togashi (herb. Y. Asahina 5677). Prov. Inaba (Pref. Tottori): Fushino, Suetsune-mura, Kedaka-gun, May 16, 1953, Y. Ikoma 3403. Prov. Oki (Pref. Shimane): Oki Islands, en route from Utaki to Nakasato, Tsuma-mura, on rock, ca. 80 m, November 30, 1984, H. Kashiwadani 20971. Prov. Bitchu (Pref. Okayama): Naraisaka, Takahashi-machi, November 8, 1931, Z. Yoshino 19. Prov. Aki (Pref. Hiroshima): Haji, Yachio-cho, Takata-gun, ca. 260 m, April 10, 1971, H. Kashiwadani 8709. Shikoku. Prov. Awa (Pref. Tokushima): Sanagochi-mura, Myoto-gun, March 14, 1956, T. Inobe 42. Prov. Sanuki (Pref. Kagawa): around Emon-no-taki Temple (Emon-fudo), Tonosho-cho, Shodo-gun (Shodo-shima Island), on rock, 350–450 m, December 18, 1998, K. H. Moon 3594. Prov. Iyo (Pref. Ehime): Mt. Ishizuchi, ca. 1800 m, September 29, 1965, M. Togashi (herb. no. 26535). Prov. Tosa (Pref. Kochi): Shakushi Pass, Hata-gun, ca. 450 m, March 25, 1983, H. Kashiwadani 19760. Kyushu: Prov. Buzen (Pref. Fukuoka), Takasumi shrine, Mt. Hikosan, Soeda-cho, Tagawa-gun, on bark of *Cryptomeria japonica*, ca. 800 m, October 8, 1996, H. Kashiwadani (39699) & Y. Umezu. Prov. Bungo (Pref. Ohita): en route from Notohge Pass to Mt. Ichino-dake, Yamakuni-cho, Shimoge-gun, on soil, 720–910 m, October 10, 1996, H. Kashiwadani (39985) & Y. Umezu. Prov. Hyuga (Pref. Miyazaki): Washizu, Aya-cho, Higashimorokata-gun, on rocks, 120–220 m, February 22, 2004, K. H. Moon 7320. Prov. Satsuma (Pref. Kagoshima): Mt. Kaimon-dake, ca. 900 m, April 6, 1970, H. Kashiwadani 2063. **Korea.** Prov. Kangwon: around Paektam temple, Mt. Sorak, Inje-gun (38°10'N, 128°22'E), on rock with mosses, 460–550 m, July 17, 1996, K. H. Moon (712) & H. Kashiwadani; around Shinhung temple, Mt. Sorak, Sorak-dong, Sokcho city (38°10'N, 128°29'E), on bark of *Juglans* sp., ca. 300 m, October 7, 1995, K. H. Moon (648) & H. Kashiwadani. Prov.

Gyungsannam-do: en route from Junngsan-ri office of Mt. Chiri National Park to Rotary shelter, Jungsanri, Sancheon-gun, on bark of *Quercus mongolica*, 900–1500 m, September 10, 2005, K. H. Moon (8601) & H. Kashiwadani. Prov. Cheju: Namcheju-gun, Namwon-up, along the Songpanak trail on E slope of Mt. Halla above the Azalea Field Shelter, *Abies koreana* forest with scattered deciduous trees (33°21'N, 126°32'E), on *Prunus* sp., 1500–1700 m, May 28, 2001, G. Thor 17511; rim surrounding the crater of Mt. Halla, rocky slope with small trees and shrubs (e. g., *Abies koreana*, *Berberis*, *Betula ermanii*, *Juniperus*, *Rhododendron* and *Salix*) (33°22'N, 126°33'E), on dead *Abies koreana*, 1850–1950 m, May 24, 2001, G. Thor 17037; en route from Youngshil Rest Area to Witsae Oreum Shelter, Mt. Halla, Cheju Island (33°21'N, 126°32'E), on bark of *Abies koreana*, 1650–1700 m, May 24, 2001, K. H. Moon 5723. **Taiwan:** Taichung Co.: Tashueshan Forest Park, below Hsiaoshuehsan Hostel, near giant *Chamaecyparis formosaensis*, Hopen (24°17'N, 121°02'E), on bark of *Pinus morrissonicola*, 2550–2580 m, November 30, 2002, K. H. Moon 6355; Rono-kei, ca. 3200 m, November 1, 1933, S. Tokio (herb. Y. Asahina 10907). Nantou Co.: just below Lo-Ying Lodge along route 14, Hohuanshan, Shi-Lin Village (24°17'N, 121°30'E), on bark of *Pinus taiwanensis*, ca. 2560 m, March 9, 2003, H. Kashiwadani 45437.

Key to the species of *Menegazzia* in Eastern Asia

1. Isidia or soredia present 2
1. Isidia and soredia absent 5
2. Isidia present 4
2. Soredia present 3
3. Perforations elevated *M. nipponica*
3. Perforations flushed *M. terebrata*
4. Medulla Pd +; thamnolic acid present
..... *M. caviisidia*
4. Medulla Pd –; squamatic acid present
..... *M. squamatica*
5. Perforations elevated 6
5. Perforations flushed *M. primaria*
6. Medulla Pd +; stictic acid present
..... *M. anteforata*
6. Medulla Pd –; caperatic present
..... *M. asahinae*

We wish to express our sincere thanks to the curators of ABL, S and UPS for the loan

of type specimens used for this study. Thanks are extended to Mr. H. Shibuichi, Kumagaya city and Mr. K. Yoshida, Saitama Museum of Natural History, for providing us valuable specimens of *Menegazzia* collected in Japan and Taiwan, and to Prof. M. R. D. Seaward, University of Bradford, for his linguistic corrections of the manuscript. This research was partly supported by a Grant-in-Aid for Scientific Research from the Ministry of Education, Science, Sports and Culture of Japan to HK (No. 02640642) and by a grant from the Core Environmental Technology Development Project for the Next Generation funded by the Ministry of Environment of the Korean Government to KHM (No. 052-052-040).

References

- Aptroot A., Lai M. -J. and Sparrius L. B. 2003. The genus *Menegazzia* (Parmeliaceae) in Taiwan. *Bryologist* **106**: 157–161.
- Asahina Y. 1927. Note on some new Japanese lichens determined by A. Zahlbruckner. *Bot. Mag. Tokyo* **41**: 369–374.
- 1932. Enumeration of *Hypogymnia* and *Menegazzia* hitherto found in Japan. *J. Jpn. Bot.* **8**: 21–22, 164–170 (in Japanese).
- 1936. Mikrochemischer Nachweis der Flechtenstoffe (I). *J. Jpn. Bot.* **12**: 516–525.
- 1950. Lichens Japoniae novae vel minus cognitae. *Acta Phytotax. Geobot.* **14**: 33–35.
- 1952. Lichens of Japan. Vol. II. Genus *Parmelia*. Research Institute for Natural Resources Shinjuku, Tokyo.
- Bjerke J. W. 2002. A new fertile species of *Menegazzia* and notes on two sorediate species from the Neotropics. *Lichenologist* **34**: 503–508.
- 2003. *Menegazzia subsimilis*, a widespread sorediate lichen. *Lichenologist* **35**: 393–396.
- 2004. Revision of the lichen genus *Menegazzia* in Japan, including two new species. *Lichenologist* **36**: 15–25.
- Culberson C. F. 1972. Improved conditions and new data for the identification of lichen products by a standardized thin-layer chromatographic method. *J. Chromatogram.* **72**: 113–125.
- Kurokawa S. 1964. Lichens. 39 pp. National Science Museum, Tokyo (in Japanese).
- 1971. Nomenclature of Japanese taxa of *Hypogymnia* and *Menegazzia*. *Misc. Bryol. Lichenol.* **5**: 129–130.
- Rassadina K. A. 1964. *Menegazzia* Mass. in URSS. *Novosti Sistematiki Nizsich rastenji* [Novitates Systematicae Plantarum non Vascularium] **1**: 235–250.
- 文 光喜^a, 黒川 遼^b, 柏谷博之^c: 東アジア産センシゴケ属 (子囊菌亜綱, ウメノキゴケ科) の分類学的研究
- 東アジア産センシゴケ属の分類学的研究を行ったので報告する. 東アジアには7種が産することを認めたが, このうち *Menegazzia nipponica* K. H. Moon, Kuroka. & Kashiw. と *M. squamatica* K. H. Moon, Kuroka. & Kashiw. は新種である. また, *M. primaria* は日本新産である. 日本の研究者に良く知られていた種名, *M. asahinae* は基準標本の検討の結果, 粉芽がなく孔が突出しカペラート酸を含む分類群に与えられるべきものと判明した. 以下, 各種について概略を述べる.
- 1) *M. anteforata* (クダチイ, 新称): 地衣体は粉芽を欠き地衣体表面の孔は突出する. 地衣成分はアトラノリンとスチクチン酸である. 従来 *M. asahinae* と呼ばれていた種は本種である. 国内では青森県から鹿児島県屋久島に至る地域と台湾の山地に分布する.
- 2) *M. asahinae* (フクレセンシゴケ): *M. anteforata* に酷似するが髄層にスチクチン酸の代わりにカペラート酸を含むので区別できる. Bjerke (2004) が伊豆・天城山から記載した *M. pedicellata* は本種の異名である. 日本特産で1920–1930年頃に天城山系と富士山御殿場, 大宮口 1–2 合目で採集されているがその後の記録はない.
- 3) *M. caviisidia* (ツブクダチイ, 新称): 地衣体は淡黄緑色で基物に密着して広がり, 表面に裂芽を持つ. 孔はまばらで突出する. 地衣成分はアトラノリンとタムノール酸を含む. 本州中部 (栃木県) 以南和歌山県に分布し台湾にも産する. ツガ, ゴヨウマツ, タイワンマツなどの針葉樹上に生育する.
- 4) *M. nipponica* (ヤマトクダチイ, 新称): *M.*

anteforata に形態、成分とも一致するが粉芽を生じるので区別できる。日本特産種で北海道から九州まで広く分布する。

5) *M. primaria* (ナメラクダチイ, 新称): 地衣体には粉芽はなく孔は突出しない。裂片は密に重なり合って成長し、表面は凸出し膨らむ。地衣成分はアトラノリンとスチクチン酸である。Aptroot 等 (2003) が台湾産標本をもとに *M. pseudocyphellata* を記載した際、子器周辺に偽盃点や亀裂を生じることを強調した。しかし、これらの形質は同一個体内でも変異が大きく安定した分類形質とは言えないので、*M. pseudocyphellata* は *M. primaria* の異名とした。本種は子器を生じることは少ないが地衣体表面には多数の粉子器を生じる。*M. terebrata* と同所的に生育すること多いが、決して粉芽を生じず、地衣体背面が凸出し地衣体は濃緑色を呈するので比較的離れた位置からでも両種を区別できる。本種は日本国内では北海道から九州に広く分布し、韓国、台湾にも産する。

6) *M. squamatica* (ウスキクダチイ, 新称):

M. caviisidia に酷似するがタムノール酸の代わりにスクワマート酸を含むので区別できる。日本特産種で本州中部の福島県、埼玉県、富山県、長野県に分布する。標本に付着した基物の状況から見てツガの樹幹に特徴的に生じると考えられる。

7) *M. terebrata* (センシゴケ): 北半球に広く分布する種で、地衣体は粉芽を持ち、孔は平坦で凸出せずアトラノリンとスチクチン酸を含むので近縁種と区別できる。Bjerke (2004) は粉芽塊が周辺部で歯状に破れる特徴を強調して *M. subsimilis* が日本に産すると報告した。しかし、本種の粉芽塊は半球状に盛り上がったものから周辺部が突出して歯状に分裂するものまで変異が多く、同一標本内でも一連の変異を示すものも多い。Bjerke が主張する形質で *M. subsimilis* を *M. terebrata* から区別することはできない。

(^aソウル大学自然科学大学生命科学部,
^b富山中央植物園,
^c国立科学博物館植物研究部)